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14. ABSTRACT

Integrated Computational Materials Engineering (ICME) has received international attention due to its great potential to shorten product and process development time, while lowering cost and improving design outcomes. ICME is an approach to designing materials for specific applications that uses computer modeling programs to predict the behavior of materials and integrate this information into the overall materials design process. The 3rd World Congress on Integrated Computational Materials Engineering (ICME) was organized by The Minerals, Metals, and Materials Society (TMS) and held in Colorado Springs, Colorado from May 31- June 4, 2015. ONR support in the amount of $15,000 was provided to support the planning, execution, and dissemination of the results of this congress.

15. SUBJECT TERMS

ICME, Computational, Materials Science, Materials Engineering, Modeling, Simulation, Experimentation

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3rd World Congress on Integrated Computational Materials Engineering (ICME)
Final Grant Report – ONR
ICME 2015, May 31- June 4, 2015, Colorado Springs, Colorado, USA

Abstract

Integrated Computational Materials Engineering (ICME) has received international attention due to its great potential to shorten product and process development time, while lowering cost and improving design outcomes. ICME is an approach to designing materials for specific applications that uses computer modeling programs to predict the behavior of materials and integrate this information into the overall materials design process. The 3rd World Congress on Integrated Computational Materials Engineering (ICME) was organized by The Minerals, Metals, and Materials Society (TMS) and held in Colorado Springs, Colorado from May 31- June 4, 2015. ONR support in the amount of $15,000 was provided to support the planning, execution, and dissemination of the results of this congress.

Project Goals and Accomplishments

Integrated Computational Materials Engineering (ICME) has received international attention due to its great potential to shorten product and process development time, while lowering cost and improving design outcomes. ICME is an approach to designing materials for specific applications that uses computer modeling programs to predict the behavior of materials and integrate this information into the overall materials design process. The 3rd World Congress on Integrated Computational Materials Engineering (ICME) was organized by The Minerals, Metals, and Materials Society (TMS) and held in Colorado Springs, Colorado from May 31- June 4, 2015. This report outlines the technical focus of the congress and provides information about the program format and the talks that took place at this event and explores the impacts and results of the event. ONR support in the amount of $15,000 was used to support the planning, execution, and dissemination of the results of this congress.

TMS has a strong history of developing specialty conferences to support the advancement of niche areas and sub-disciplines within the overall field of materials science and engineering. Some recent, notable examples include "Superalloys 2012: The 12th International Symposium on Superalloys" which was held from September 9 to 13, 2012; the "1st International Congress on 3D Materials Science, which was held from July 8 to 12, 2012; the "2nd International Congress on 3D Materials Science, which was held from June 29 – July 2, 2014; the "1st World Congress on Integrated Computational Materials Engineering," which was held from July 10 to 14, 2011; and the "2nd World Congress on Integrated Computational Materials Engineering," which was held from July 7-11, 2013.

This congress was a follow up to the highly successful 1st and 2nd World Congresses on ICME and continued the advancement of the discipline of Integrated Computational Materials Engineering by providing the premier world venue for the sharing and dissemination of the latest scientific and engineering advances in this technical niche area. TMS drew on the ICME expertise and connections of its volunteer organizing committee to assemble a world class technical program which included both podium and poster presentations. Finally, it was the goal of the organizers to ensure continued dissemination of the high quality, high impact technical content by publishing much of the research in the conference proceedings which were made available to attendees as a hard cover book which includes a cd with the conference papers in PDF form. The books are also available at www.wiley.com and individual conference papers in PDF format are available at http://onlinelibrary.wiley.com .

Another goal of the conference was the rollout of the final report of a comprehensive TMS-led and NIST sponsored roadmapping study for connecting materials models and simulations across length and time scales. Compiled by a team of internationally recognized experts, this report reviews the current state of the art of multiscale materials modeling, identifies gaps and limitations, and details sixteen recommendations that address bridging of materials models across length and time scales. The intent of publically rolling out the report at the ICME congress was to provide ICME practitioners and researchers guidance in overcoming the challenge of effectively linking materials models across length and time scales, in order to accelerate materials-based technological innovations.

The principal goal for the $15,000 grant support provided by ONR was to provide financial support to assist TMS in carrying out the various necessary phases of the planning, execution, and result-dissemination efforts of the Congress. In particular, support was provided for partial support of the congress proceedings, student poster awards, conference programming, administrative support, promotions of the event, and meeting room and audiovisual equipment rental.

Major Activities

The 3rd World Congress on Integrated Computational Materials Engineering (ICME) featured presentations of cutting edge technology in 20 podium presentation sessions and 2 poster presentation sessions. Additionally, a panel discussion on the last day of the conference provided venues for congress participants to interact in an open fashion while focusing in on topics centered about the future directions of ICME. There was also an ICME Tools Showcase at the congress, and the roadmapping study on "Connecting Materials Models and Simulations Across Length and Time Scales" was also released during the congress, and was highlighted in a talk during the closing plenary session of the meeting.

Overall, the congress final planned program presentations included 122 podium presentations and 45 poster presentations across 22 sessions. The following list of sessions also serves as a brief sampling of the specific areas covered at the conference.

- Plenary Session I
- Process and Performance Modeling I

- Applications I: Lightweight Materials
- Modeling at Different Scales I
- ICME Models, Tools and Infrastructure I
- Applications II: Ferrous
- Modeling at Different Scales II
- Poster Session I
- ICME Implementation and Case Studies
- Applications III: Composites and Non-Ferrous
- ICME Models, Tools and Infrastructure II
- Plenary Session II
- ICME Tools Showcase
- Poster Session II
- Plenary Session III
- ICME Models, Tools and Infrastructure III
- Process and Performance Modeling II
- Modeling at Different Scales III
- ICME Models, Tools and Infrastructure IV
- Modeling at Different Scales IV
- Applications IV
- Plenary Session IV
- Plenary Session IV
- Panel Discussion

Project Participants

This conference was organized by both volunteers and staff from The Minerals, Metals, and Materials Society. The staff and volunteers involved in this effort organized all aspects of the conference technical program, the logistical details of the conference such as location and arranging all equipment needed, and the technical exhibit. The staff and volunteers also organized and developed the conference proceedings.

George Spanos, Technical Director
Lisa Breese, Programming Specialist
Dave Rasel, Media Manager
Janel Show, Marketing Data & Support Specialist
Ken Grzegorcyzk, Web Developer
Louise Wallach, Events, Programming, & Sales Senior Manager
Trudi Dunlap, Programming Manager
David Howe, TMS Technical Initiatives Developer
Justin Scott, TMS Technical Project Leader

Marleen Schrader, TMS Accounting and Human Resources Specialist

Volunteer Organizing Committee:
Warren Poole (Chair), University of British Columbia, Canada
Steve Christensen, Boeing, USA
Surya Kalidindi, Georgia Institute of Technology, USA
Jonathan Madison, Sandia National Laboratories, USA
Dierk Raabe, Max-Planck Institute, Germany
Xin Sun, Pacific Northwest National Laboratory, USA
Alan Luo, Ohio State University, USA

Resulting Publications

Following the conference, dissemination of the results continued via the conference proceedings of the ICME 3rd World Congress. A large number of submitted and invited presentation papers were published in the proceedings, which were made available to attendees as a hard cover book which includes a cd with the conference papers in PDF form. The books are also available at www.wiley.com and individual conference papers in PDF format are available at http://onlinelibrary.wiley.com.

By way of example, some select papers from the ICME 3rd World Congress Proceedings include*:
- ICME for Process Scale-Up: Importance of Vertical and Horizontal Integration of Models, G. Tennyson, R. Shukla, S. Mangal, S. Sachi, and A.K. Singh.
- Finite Element Model for Plymouth Tube Processing Using Internal State Variables, H. Cho, M.F. Horstemeyer, Y. Hammi, and D.K. Francis
- ICME Towards Improved Understanding of Bainite in 100CR6, W. Song, W. Bleck, and U. Prahl
- From Integrated Computational Materials Engineering to Integrated Computational Structural Engineering, R. Dutton, P. Kobryn, D. Ball, J. Castle, M. James, and P. Yavari
- Microstructure Modelling in ICME Settings, G.J. Schmitz, B. Böttger, and M. Apel
- Development of an ICME Approach for Aluminum Alloy Corrosion, K.D. Smith, M. Jaworowski, R. Ranjan, and G.S. Zafiris
- ICME Applications in Optimizing Welding and Thermal-Forming Processes, Y.-P. Yang, H. Kim, B. Mohr, H. Castner, T.D. Huang, and D. Fanguy
- Design of Co-Free Cemented Carbides, M. Walbrühl, J. Ågren, and A. Borgenstam
- nanoHUB as a Platform for Implementing ICME Simulations in Research and Education, T. Faltens, A. Strachan, and G. Klimeck
- An Integrated Collaborative Environment for Materials Research, M.D. Jacobsen, M.D. Benedict, B.J. Foster, and C.H. Ward
- ICME for the Integrated Design of an Automotive Gear Considering Uncertainty, B.P. Gautham, N. Kulkarni, P. Zagade, J.K. Allen, F. Mistree, and J. Panchal
- Uncertainty Management in the Integrated Realization of Materials and Components, J.K. Allen, J. Panchal, F. Mistree, A.K. Singh, and B.P. Gautham

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